**Topics in Atmospheric Chemistry – CHM1415F**

This course considers the processes that control the chemical composition of the atmosphere related to stratospheric ozone depletion, tropospheric oxidation processes, urban air pollution, and acid rain. As well, we will address more advanced topics in chemistry-climate coupling, aerosol chemistry, and the role of the biosphere. Emphasis will be given to new research findings by discussing recent papers from the literature. An expectation is that you will become comfortable with current research in atmospheric chemistry.

***Prerequisites***

None. However, we will be building upon what undergraduates in the course may have learned in CHM210, so you are encouraged to read in an introductory environmental chemistry textbook (e.g. Baird and Cann) if you feel you need to catch up.

***Schedule***

Lectures: Mon/Wed, 9 to 10 am, Lash Miller 155

***Grading***

| | |
|---|---|
| Problem Sets | 10% |
| Mid-term | 15% |
| Discussion paper summaries | 15% |
| Participation during the discussion of papers | 10% |
| Seminar summaries | 10% *** |
| Final Exam | 40% |

Problem sets – There will be four problem sets due in class, as a paper submission.

Mid-term – Closed book, to be held in LM155 from 9:10 to 10:00 on Monday, October 21

Discussion papers – We will discuss in class six papers from the literature. Please come prepared to discuss each of these papers. You are required to hand-in one-page summaries of the papers before the class in which they are discussed (see last page for format).

Seminar summaries – Please attend five seminars on atmospheric chemistry/global change science/environmental chemistry during the semester, handing in a one-page summary within one week of the seminar. Please confirm with me if the seminars you choose to attend are eligible. *** If you don't want to do the seminar summaries, then we can work together on developing a short independent project to work on.

Final exam – during the undergraduate exam period, 3 hours, closed book.

NOTE: No credit will be given for late problem sets or summaries, or for a missed mid-term unless there is a medical (or equivalent) justification. In those cases, the assignment will not count and your other scores in the course are pro-rated accordingly.

***Contact Information for Jon Abbatt***

Office: Lash Miller 324; Tel: 946-7358

Email: jonathan.abbatt@utoronto.ca

Office hours: to be arranged once everyone's schedules are firm

NOTE: Please contact me if you have questions. Conceptual issues are best handled before or after class, at office hours, or by special appointment. Email is good for short questions.

***Important Course Announcements***

Important course announcements will NOT necessarily be made on Quercus. As an example, if I give advice on how to solve a problem set, that will be covered in class and not on Quercus.

***Textbook*** *(these books are available free online).*

You are only responsible for material and papers covered in class, and not for additional material from the textbooks. That said, the recommended textbook for the course is:

*Introduction to Atmospheric Chemistry, D.J. Jacob, Princeton University Press (http://acmg.seas.harvard.edu/people/faculty/djj/book/index.html)*

However, Jacob will not cover everything we do. Another excellent reference is:

*Chemistry of the Upper and Lower Atmosphere, B.J. Finlayson-Pitts and J. Pitts, Academic Press (available as an e-book through UofT libraries)*

***Academic Integrity***

Discussing course material and assignments with others in the class can be a valuable learning experience; I encourage it. **However, any material that you submit must be your own, independent work. It is plagiarism to submit a problem set or paper summary that contains material copied from another student.** Please consult the following website on academic integrity/misconduct: https://www.artsci.utoronto.ca/current/academic-advising-and-support/student-academic-integrity-osai/academic-misconduct

## Lecture Schedule

This lecture schedule is just a rough outline for where we are heading - please don't hold me to it! Each lecture labeled with an * will involve discussion of papers from the literature. I will give you at least one week warning in advance of the class involving paper discussion.

**Introduction**

Lecture #1 – Global change, formation, and overall composition of the atmosphere

**Fundamentals**

Lecture #2 – Atmospheric photochemistry and kinetics
Lecture #3 – Atmospheric photochemistry and kinetics
Lecture #4 – Atmospheric chemistry models
Lecture #5 – Atmospheric mixing processes

**Stratospheric Ozone Depletion**

Lecture #6 – Mid-latitude ozone
Lecture #7 – Mid-latitude ozone
Lecture #8 – Polar ozone
* Lecture #9 – Current understanding of ozone depletion (Ravishankara paper)

**Tropospheric Oxidation**

Lecture #10 – Tropospheric chemistry: OH, $NO_x$, CO, $CH_4$
* Lecture #11 – Tropospheric chemistry: OH, $NO_x$, CO, $CH_4$ (Turner paper)
Lecture #12 – Tropospheric chemistry: OH measurements
Lecture #13 – Tropospheric chemistry: VOC oxidation
* Lecture #14 – Tropospheric chemistry: Biogenic VOCs (Lelieveld paper)
Lecture #15 – Urban ozone and pollution control
* Lecture #16 – Tropospheric chemistry: Sulfur oxidation (Cheng paper)
Lecture #17 – Marine halogens

**Atmospheric Chemistry and Climate**

Lecture #18 – Climate System and radiative forcing
Lecture #19 – Climate System and radiative forcing
Lecture #20 – Clouds and climate
* Lecture #21 – Clouds and climate (Quinn paper)
* Lecture #22 – Geoengineering (Crutzen paper)
Lecture #23 – A special lecture, if we have time

**Summaries: Papers from the literature and seminars**

Please come to class prepared to discuss each paper. I expect everyone to speak up, and I will be calling on people to answer questions. In particular, come with some questions that you would like answered. 10% of your total grade in the course is based on participation, assessed at the end of the semester by how much you participate and by the quality of your contributions.

Each summary should address the following questions, using the indicated headings. It should be one page long (single spaced, 11- to 12-pt font, small margins). Below is an indication of roughly how long each section should be but use this as a guide only. In particular, if the summary is slightly longer or shorter than one page, that is fine. I just don't want to have to read long essays!

1. Topic: What is the topic of the paper? (5 lines)
2. Importance: Why is the topic important to the field of atmospheric chemistry? (5 lines)
3. Methods: What methods were used? (5 to 10 lines)
4. Insights: What new insights does this paper present? (15 to 20 lines)
5. Uncertainties: What is (are) the major unresolved issue(s) in this field? (5 to 10 lines)
6. Questions: Write two questions that you would have asked the author had this paper been presented as a seminar? (5 lines)

These summaries must be submitted at the start of class (or before) in which we discuss the paper.

As well, please submit summaries of the five seminars you attend during the semester. You may use the above format, or else one of your own choosing that covers similar content.